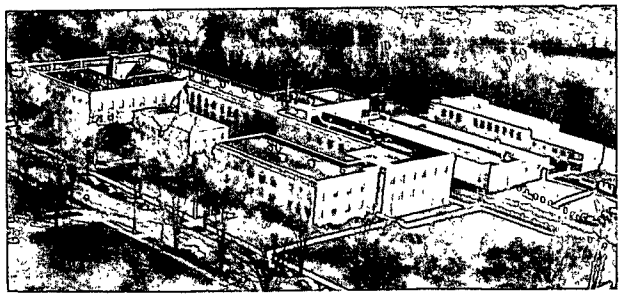

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

Project 2256

Report Twenty-Two

A Monthly Report

to

U. S. ARMY CHEMICAL CENTER PROCUREMENT AGENCY

Report Period: July 29, 1962 to August 28, 1962

October 2, 1962

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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Project 2256

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THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

DEVELOPMENT OF AN IMPROVED DIFFUSION BOARD MATERIAL

SUMMARY

A series of boards was made at the Wood Conversion Company laboratory in Cloquet, Minnesota. Boards were made with stock similar to the preproduction trial stock with and without sizing using water from the available supplies (city and river) with and without pH adjustments. This work was done in an effort to pin down the factors responsible for the poor gas life performance of the pre-production trial products. Gas life tests run on the boards gave no definite indication that any of the materials involved in the production of this board at Wood Conversion Company would be deleterious at the prescribed addition levels and concentrations. There was a slight indication that the use of the charcoal in a slurry form could result in poor gas life due to leaching and settling before addition. The factors directly affecting the gas life performance of the trial product may have resulted from conditions not readily duplicated in the laboratory.

LABORATORY STUDIES CONDUCTED AT THE WOOD CONVERSION COMPANY

BACKGROUND

Some conjecture has been made concerning the factors that may have been responsible for the poor gas life performance of the board produced in the preproduction trials at the Wood Conversion Company. However, no single condition or group of conditions have been discovered that was directly responsible for the gas life performance of the product. Boards produced at the Institute using samples of pulp from the trials (see Reports 19 and 20) had satisfactory and predictable gas lives. Evidently, the responsible factors were peculiar to conditions existing at Wood Conversion's Cloquet mill or to materials used at the Cloquet mill. Consequently, while awaiting an opening in the schedule for making the production run, it was decided that a series of boards involving as many of the conjectured factors as possible in the form of variables should be formed in Wood Conversion's Cloquet laboratory.

LABORATORY WORK

A barrel of stock was taken from the grinder chest in the mill. This stock was essentially the same as the stock used in the preproduction trials. It was washed before being used to form boards by diluting 2-liter quantities with river water to a consistency of approximately 1% and draining in an 8 x 8-inch sheet mold. The pad from the mold was pressed to a thickness of one-half inch in a hydraulic press, redispersed, drained, and pressed.

The slurry for each board formed was dispersed at a consistency of 3% with a Lightnin' mixer, additions were made, and the slurry was diluted to 1.0 to 1.5% consistency in the deckle box of an 8 x 8-inch sheet mold. The boards were formed on a 16-mesh (approximate) wire, pressed in a hydraulic press to a given

thickness, and dried for three hours in a circulating-air oven set at 105°C. The first three boards (1-1,2,3) were compressed to a thickness of 0.175 inch and found to be too dense. The next board was compressed to a thickness of 0.200 inch and found to be too dense. The remaining boards were compressed to 0.250 inch as this was found to result in a satisfactory density.

The furnish for a sized board consisted of:

122 g.	ovendry fiber
10 cc.	Aquapel 360 (0.5% addition)
2.4 cc.	Kymene 557 (0.2% addition)
30.5 g.	ASC Charcoal (25% addition)

Three boards were formed for a given condition. The additives used in these boards were, with two exceptions, taken from the same batches as were used in the preproduction trials. With one exception, all of the boards were formed from the laboratory-washed pulp. The pH of the river water was 7.32; this water was dark brown in color. The city water was colorless and it had a pH of 7.54.

Sized and unsized boards were formed in river water, with and without additions of caustic soda to the slurry for pH adjustment, and with the charcoal added directly to the stock slurry, at room temperature and at 120°F. Similarly, sized boards were formed at room temperature with pH adjustment and with the charcoal added as a 25% slurry in city water. A set of boards was formed in city water, a set was formed using charcoal from the Institute supply, and a set was formed with a sample of pulp from the second preproduction trial and charcoal from the Institute supply. A description of the boards formed is given in Table I.

Although spot checks were run on the dryness of the board specimens as they were removed from the oven, it is possible that some of the boards were not properly dried. The possibility of this happening is borne out by the fact that it was necessary to give the last nine board specimens an additional one-half hour

TABLE I

DESCRIPTION AND TESTING OF BOARDS FORMED IN WOOD CONVERSION COMPANY LABORATORIES

Sample No.	Pulp	Water Supply	Temp., °F.	Sizing	Charcoal			Forming Slurry		Estimated Charcoal Loading, g./100 sq.cm.	CK Life, min.	Critical Bed, g./100 sq.cm.
					Supply[a]	How Added	pH of Charcoal Slurry	Caustic[b] Added?	pH			
1-1,2,3	Lab[c]	River	65	Yes	WCCO	Dry	--	No	7.8	6.85	68	4.29
2-1,2,3	Lab	River	120	Yes	WCCO	Dry	--	Yes	7.8	6.37	51	4.45
3-1,2,3	Lab	River	120	No	WCCO	Dry	--	Yes	7.8-8.2	6.14	75	3.31
4-1,2,3	Lab	River	65	Yes	WCCO	25% slurry (city water)	8.4	Yes	8.4	6.20	39	4.73
5-1,2,3	Lab	River	65	Yes	WCCO	25% slurry[d] (city water)	8.4	Yes	8.5-8.6	6.35	30	5.22
6-1,2,3	Lab	River	65	Yes	WCCO	Dry	--	Yes	8.4	6.42	36	5.06
7-1,2,3	Lab	River	65	No	WCCO	Dry	--	Yes	8.3-8.6	6.38	65	3.93
8-1,2,3	Lab	City	65	Yes	WCCO	Dry	--	No[e]	7.7-7.8	6.43	37	5.03
9-1,2,3	Lab	River	65	Yes	Institute	25% slurry (city water)	8.3	Yes	8.5-8.6	6.48	34	5.20
10-1,2,3	2nd preproduction trial code 63-3	River	65	Yes	Institute	Dry	--	Yes	8.4	6.83	84	3.67

[a] WCCO denotes charcoal on hand at Wood Conversion Company for production trials (see Report 18 for description). Institute denotes charcoal used at Institute for laboratory studies (see Report 3 for description).

[b] Two per cent caustic soda solution used for pH control.

[c] Sample of pulp from mill-refiners, washed in laboratory.

[d] pH of water used to slurry charcoal adjusted to 9.12 before charcoal addition.

[e] pH of specimen 8-1 inadvertently adjusted to 9.0; did not seem to affect critical bed.

of drying at 250°F. The dried boards were sealed in polyethylene bags immediately after removal from the oven. The sealed bags of boards were shipped to Army Chemical Center for CK life testing. Samples of the pulp taken before and after washing were brought to the Institute for testing.

TESTING AND RESULTS

The pulp samples brought to the Institute were tested for ash, water solubles content, and pH of the hot water extract. The results of these tests along with the results of the same tests on the washed stock used in the second trial are listed in Table II. These tests do not indicate any gross differences in the pulps other than a very high water solubles content in the unwashed laboratory stock and the low ash content of the washed laboratory stock. The low ash content is most likely due to freedom from mineral fiber contamination in the production pipe lines. The reason for the high water solubles of the unwashed stock is not readily apparent; however, it may be because the stock was not diluted when it was taken from the refiner.

Gas life tests showing variations substantially greater than would be expected in the form of experimental error were found in the gas lives of the specimens of some of the sets of boards. The results of tests on the specimens are presented in the table appended to this report. The variations in the gas lives of the specimens comprising Set 1-1,2, and 3 may be accounted for in that there was some question when the boards were formed as to whether an error had been made in weighing the charcoal additions for at least one of the boards, in which case 27.0 g. of charcoal would have been added instead of 30.5 g. The other board sets in which the variations were large were those sets in which the charcoal had been added in slurry form. The charcoal additions for each set of boards were made volumetrically from a single slurry. The gas life and the areal weight increased

with the order in which the boards were formed, indicating that, even though the charcoal slurries were under almost constant agitation, some settling took place before they could be added to the stock slurries.

TABLE II

RESULTS OF TESTS ON WOOD CONVERSION COMPANY PULP SAMPLES

Sample No. 2256-2085-	Description	Ash,[a] %	Hot Water[a] Solubles, %	Hot Water[b] Extract, pH
69-1	Stock obtained for lab boards--unwashed	3.82	19.0	6.0
69-2	Stock obtained for lab boards--washed	0.78	3.19	5.7
63-1	2nd preproduction trial--grinder chest stock	1.46	6.48	5.4
63-2	2nd preproduction trial--sample after 1st washing	2.17	2.93	6.7
63-3	2nd preproduction trial--sample after 2nd washing	2.12	2.67	6.3

[a]Ovendry basis.
[b]As received basis.

The averaged results of the gas life testing of the board specimens and the critical beds calculated from the test results are presented in Table I. The following observations were drawn from these data:

1. The washed pulp (2085-63-3) used in the second WCCO pilot trial had a water solubles content of 2.67% (Table II). According to the water solubles-gas life curve for sized boards, a sized board formed from this pulp should have a critical bed of 3.67 g./100 sq. cm. (Report 19). The average critical bed of sized boards formed from this pulp at a pH of 8.4 using charcoal from the Institute's supply and WCCO river water was 3.67 g./100 sq. cm. This would indicate that at least under alkaline conditions the use of WCCO's river water has no more effect on CK life than the Institute's city water supply.

2. The washed pulp made up especially for this laboratory work had a water solubles content of 3.19% (Table II). Sized boards formed from this pulp should have a critical bed of 3.85 g./100 sq. cm. (Report 19). The average critical bed of sized boards formed from this pulp at a pH of 8.4 using charcoal from the WCCO supply and WCCO river water was 5.08 g./100 sq. cm. It would seem from this that either the pulp affected the activity of the charcoal or the charcoal was in a very deteriorated state before its use. A set of unsized boards formed in the same manner had a critical bed of 3.94 g./100 sq. cm., which is still higher than the predicted bed for a sized board.

3. There were no differences in the critical beds of boards formed with pH adjustments and boards formed without pH adjustments; however, the systems were alkaline at all times.

4. In general, the average critical beds of the boards containing charcoal added in a slurry form were higher than the critical beds of counterpart boards formed with direct charcoal additions, although the differences are not well defined. This would seem to indicate some loss of charcoal activity as a result of its use in slurry form.

5. The use of hot water in forming the boards did not result in any appreciable increases in critical beds. As a matter of fact, the unsized boards of this series had the lowest critical bed of all the series.

6. While the critical beds were high, none of the boards produced had the near zero gas lives that were obtained in the WCCO pilot trials.

CONCLUSIONS

These results indicate no deleterious effects due to the water supplies and, as long as the systems are alkaline, no pH adjustment is necessary in the forming of the boards. Drying or other factors not readily duplicated in the laboratory may be the cause of the poor performance of the pilot trial boards. The use of hot water has no serious effects. Slurrying of the charcoal before addition to the furnish may have some effect on the activity of the charcoal due to leaching, although no profound effects were noted. There were indications that the charcoal was not well dispersed in the laboratory-produced slurries, even though continually agitated (however, not violently). Consequently, in any future machine trials particular care should be taken in keeping the charcoal slurry well agitated and minimizing the time between the make-up and use. On the basis of this laboratory work, it does not seem likely that any of the materials used to produce the board directly affect the gas life to the extent that the WCCO pilot trial boards were affected.

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